Implications for Rehabilitation

- Functioning of patients with COPD can be comprehensively assessed in a worldwide common language - the ICF.
- Rehabilitation interventions for patients with COPD should be designed according to the ICF framework, i.e., assessing and monitoring Body functions, Body structures, Activities and participation and Environmental factors.

Chronic Obstructive Pulmonary Disease and functioning: implications for rehabilitation based on the ICF framework

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Abstract

Purpose: This study aimed to describe the functioning of patients with COPD according to the ICF framework to inform future rehabilitation interventions.

Method: A cross-sectional study with a convenience sample of outpatients with COPD was conducted. Data were collected using the Comprehensive ICF Core Set for Obstructive Pulmonary Diseases. Descriptive and inferential statistics were applied.

Results: In total, 119 participants (71.43% male) with a mean age of 68.71±11.61 years old were included. The frequency and extent of the majority of the impairments assessed were similar among participants at different COPD grades. The most relevant (frequency>70%) Body functions and structures impairments were related to exercise tolerance functions, sensations associated with cardiovascular and respiratory functions and respiratory system structure. Mobility and domestic life restrictions were the most frequently reported in the Activities and participation component. Products for personal consumption, immediate family, health professionals and their attitudes were most frequently understood as facilitators whilst climate and air quality were perceived as barriers.

Conclusions: Recommendations were drawn from this study in order to improve comprehensive rehabilitation interventions for patients with COPD based on ICF framework.

Introduction

The Chronic Obstructive Pulmonary Disease (COPD) currently affects 210 million people around the world [1]. According to the Global Initiative for Chronic Obstructive Lung Disease (GOLD), COPD is a progressive condition that can be classified into four grades [2]. At earlier grades (GOLD 1 and 2), the condition is mainly characterised by airflow limitation however, as the disease progresses (GOLD 3 and 4), exacerbations and comorbidities contribute to a high disability [2].

Since COPD can become a highly incapacitating disease, it is imperative to organise and plan health care for patients with COPD at its different grades. Several international guidelines have been recommending rehabilitation as a first line intervention for patients with COPD, since it is the multi and interdisciplinary management of a person's functioning and health [2-4]. However, the international rehabilitation recommendations have been based in patients' problems and needs assessed through condition-specific health-status measures. These measures typically cover selected aspects of the patient's health experience and do not consider all factors impacting on health and functioning of patients [4]. These guidelines also have failed in providing a meaningful standard language to all agents involved in planning rehabilitation interventions across the world [2,3]. Therefore, a comprehensive specification of symptoms and limitations in functioning of patients with COPD in a worldwide common language about health is needed for decision-making purposes.

The International Classification of Functioning, Disability and Health (ICF), approved by the World Health Organization (WHO) as an official member of the WHO Family of Classifications in May 2001, reflects the biopsicossocial model in a unified and coherent view of various dimensions of health (biological, individual and social) [5]. Moreover, ICF allows the establishment of a standard language for describing health, which is not possible using other classifications [5]. Thus, describing the functioning of patients through the ICF framework may improve the communication between different users that are needed to be involved in the design of comprehensive rehabilitation interventions, such as health and social professionals, researchers, policy-makers, patients and families [5]. Therefore, ICF provides an appropriate framework to plan and implement guidelines in COPD rehabilitation.

The main aim of this study was to comprehensively assess the functioning of patients with COPD according to the ICF framework to inform the development of future rehabilitation interventions.

Specifically the study aimed (i) to investigate the frequency and extent of the impairments of participants with COPD and (ii) to examine the differences among COPD grades.

Methods

Study design and participants

A cross-sectional study with a convenience sample of outpatients with COPD was conducted in the central region of Portugal. The study received full approval from the Ethics Committees of the Center Health Regional Administration and of the São Sebastião Hospital. Potential participants were identified by clinicians from the institutions involved (two primary care centers and one hospital) and the recruitment occurred from December 2010 to October 2011. Participants were included in the study if they: i) were diagnosed with COPD (International Statistical Classification of Diseases and Related Health Problems (ICD-10) codes J40-J44) according to the GOLD criteria; ii) were 18 years of age or older and iii) were able to understand the purpose of the study and voluntarily consent to participate. Participants were excluded from the study if they presented severe psychiatric conditions and/or inability to understand and co-operate.

Instruments

As the ICF classification comprises over 1400 categories, ICF Core Sets have been developed, which represent a selection of ICF categories describing the prototypical spectrum of impairments in the functioning of patients with a specific health condition [6]. For Obstructive Pulmonary Diseases (OPD), where COPD is included, two types of ICF Core Sets have been developed: the brief and the comprehensive. The brief core set is composed by minimum data to be used at any clinical encounter [6]. The comprehensive core set has the ability to collect more information and it is indicated to guide multidisciplinary assessments in the rehabilitation process [6]. Therefore, in this study, functioning was assessed with the Comprehensive ICF Core Set developed for OPD as it was intended to inform rehabilitation [7]. The current version consists of 71 categories, 19 of which assess the Body functions, 5 the Body structures, 24 the Activities and participation and 23 the Environmental factors [7]. This instrument follows the ICF categories which are designated by specific letters, i.e., ‘b’ for Body functions, ‘s’ for Body structures, ‘d’ for Activities and participation and ‘e’ for Environmental factors.

These categories are followed by a numeric code which first digit represents the ICF chapter number. More detailed information is given through adding a second (2 digits), third and fourth levels (1 digit each). For example, in the Body functions there are these codes:

b2 Sensory functions and pain (first-level)

b280 Sensation of pain (second-level)

b2801 Pain in body part (third-level)

b28010 Pain in head and neck (fourth-level)

For the Body functions, Body structures and Activities and participation components, the extent of the patients' impairments was quantified on a 0 to 4 qualifier scale, corresponding to no, mild, moderate, severe and complete impairment, respectively. The Activities and participation component enables the assessment of both participation restrictions and activity limitations. However, to assess activity limitations, a standardised environment is needed to neutralise the impact of different environments on each individual's ability [5]. As this study was conducted in different clinical settings it was only possible to assess the frequency and extent of the participation restrictions. The qualifier scale of the Environmental factors component ranged from -4 to 4, since an environmental factor can be a barrier (-1 mild,-2 moderate,-3 severe and -4 complete), a facilitator (1 mild, 2 moderate, 3 substantial and 4 complete), or can have no influence (0) on a patient's functioning. Additionally, in all four ICF components, "8 - not specified" was used when the available information was not sufficient to quantify the severity of the problem, and "9 - not applicable" when a category was not applicable to a specific patient.

Data collection procedures

Socio-demographic (gender, age and occupation situation), anthropometric (height and weight) and clinical (medication and comorbidities) data were first recorded. Patients were interviewed by a health professional trained in the application and principles of the ICF. The Comprehensive ICF Core Set for OPD was filled using information from participants (interview and observation), from proxies (i.e., a spouse or close relative, who could also have the role of a carer), from medical records and from a physical exam. The physical exam included the assessment of: i) height and weight, which were measured using a calibrated digital scale; ii) vital signs, arterial blood pressure and heart rate

measured with a digital automatic blood pressure monitor (HEM-742 INT, Omron Healthcare Co., Ltd., Japan) and respiratory rate which was determined manually; iii) airflow obstruction, which was measured with a portable spirometer (MicroLab 3500, CareFusion, Kent, UK); iv) mobility, which was determined by the "Timed up and go" Test as it is a reliable and valid test for quantifying functional mobility [8]; and v) peripheral oxygen saturation before, during and after the "Timed up and go" Test, which was monitored with a portable pulse oximeter (Pulsox-300i, Konica Minolta Sensing, Inc., Osaka, Japan). On average, the Comprehensive ICF Core Set for OPD lasted 55±17 minutes to complete.

Data analysis

Descriptive statistics were used to describe the sample and to examine the frequency and extent of participants' impairments in the Body functions and structures, Activities and participation and Environmental factors components. In order to perform these descriptive statistics some qualifiers were recoded. The ICF qualifier "9 - not applicable" was recoded to "0 - no impairment", whereas the response option "8 - not specified" was treated as missing. As considered by previous authors, categories with frequencies below 30% were considered not relevant, above 30% were considered relevant and above 70% as the most relevant [9-11].

To investigate the differences in the frequency of the impairments among participants at different COPD grades, the Chi-square Test was performed since it is the statistical test used to investigate whether distributions of categorical variables differ from one another [12]. When a statistically significant difference was found, chi-square multiple comparison tests with Bonferroni correction were performed to explore which COPD grades differ from each other. To investigate the differences in the extent of the impairments among the four COPD grades and since the qualifiers of the ICF are defined in an ordinal scale, the Kruskal-Wallis Test was used. When a statistically significant difference was found, multiple comparison tests were performed. The level of significance considered was 0.05. Statistical analyses were performed using PASW Statistics (Predictive Analytics Software) version 18.0 for Windows (SPSS Inc., Chicago, Illinois).

Results

Sample characterisation

A total of 128 patients were approached for inclusion in the study, however 7 did not want to participate and 2 did not complete the assessment. Therefore, 119 participants (71.43% male; age, 68.71±11.61 years old) were included in the study. Most participants were married (n=95; 79.83%) and were currently retired (n=96; 80.67%). Their mean FEV_1 percentage predicted was 57.33±22.22 (ranged from 16 to 99) and mean FVC was 69.82±20.21 (ranged from 22 to 119). Twenty-six (21.80%) participants were current smokers and 14 (11.80%) were on long-term oxygen therapy. According to the GOLD criteria, 70 participants had COPD at earlier grades (GOLD 1 and 2) and 49 at advanced grades (GOLD 3 and 4). It was verified that participants at advanced COPD were older than those at earlier grades. Table 1 describes the socio-demographic and clinical characteristics of the sample.

Insert table 1 about here

Body functions

Table 2 presents the frequency and extent of the participants' impairments in the Body functions component. Seventeen (89.47%) of the 19 categories included in the body functions component of the Comprehensive Core Set for OPD were relevant impairments for the participants studied. The most frequent impairments (frequency above 70%) were related to the sensations associated with cardiovascular and respiratory functions (n=111, 93.28%) and to exercise tolerance (n=111; 93.28%), respiratory muscle (n=97; 81.51%), respiration (n=90; 75.63%) and emotional functions (n=90; 75.63%). On the other hand, the functions of voice and of the haematological system were the categories considered less frequently impaired (frequency below 30%). The extent of the impairments is shown in table 2. Exercise tolerance functions and sensations associated with cardiovascular were those rated with more severity (median 3).

When the four grades of COPD were compared (table 2), it was observed that both frequency and extent of the impairments were similar among the different COPD grades. However, exceptions were identified for the sensations associated with cardiovascular and respiratory systems functions and for the exercise tolerance, respiratory muscle and respiration functions, where both frequency and extent increased from GOLD 1 to GOLD 4. Regarding the frequency, it was verified that impairments in

respiratory muscle functions were significantly less frequent in participants at GOLD 1 (p=0.001) and that impairments in muscle power and muscle endurance were reported significantly more often by participants at advanced grades (p=0.001 and p=0.002). In relation to the extent, impairments in sensations associated with cardiovascular and respiratory systems functions and in exercise tolerance and respiratory muscle functions were significantly more severe at advanced grades than at earlier grades (p=0.006, p=0.001, p=0.001, respectively).

Insert table 2 about here

Body structures

Table 3 presents the frequency and extent of the participants' impairments in the Body structures component. Two categories (40%) of the 5 included in the Body structures component of the Comprehensive Core Set for OPD were relevant impairments for the participants studied. All participants presented impairments in the respiratory system structure and more than half (n=66; 55.46%) in the cardiovascular system structure. Impairments in the structures of the trunk (n=26; 21.85%), head/neck (n=22; 18.49%) and shoulder (n=12; 10.08%) were less frequent in this sample of patients with COPD. There was no obvious difference in the frequency of impairments in this ICF component among the four grades of COPD. However, in relation to the extent of the impairments, participants at GOLD 3 and 4 had significantly more severe impairments in the respiratory system structure, than participants at GOLD 1 and 2 (p=0.001).

Insert table 3 about here

Activities and participation

The frequency and extent of difficulties reported in the Activities and participation component are presented in table 4. Nineteen (79.17%) of the 24 categories included in this ICF component of the Comprehensive Core Set for OPD were relevant for the participants studied. The most frequent limitations were moving around (n=106; 89.08%), which was also the difficulty experienced with more severity (median 3), moving around in different locations (n=97; 81.51%) and acquiring goods and services (n=85; 71.43%). More than half of the participants also reported difficulties in recreation and

leisure (n=75; 63.03%), doing housework (n=71; 59.66%), dressing (n=68; 57.14%), caring for household objects (n=64; 53.78%) and using transportation (n=60; 50.42%).

When the frequency and extent of the difficulties among the different grades of COPD were analysed (table 4), it was observed that both increased from GOLD 1 to GOLD 4 in the difficulties related to the ICF chapters d2 general tasks and demands (d230, d240), d4 mobility (d455, d460, d450, d430, d410, d475, d4750), d5 self-care (d540 and d510), d6 domestic life (d650) and d9 community, social and civic life (d910 and d920). Statistically significant differences in the frequency were found in all these categories, with the exception of d230, d455 and d460. However, in relation to the extent, statistically significant differences were found just in the categories d230 and d455.

Difficulties related to assisting others, speaking, remunerative employment, moving around using equipment and acquiring, keeping and terminating a job were less frequent in the sample studied. Nevertheless, when the frequency of these impairments among COPD grades were analysed, it was observed that both assisting others and speaking were significantly more frequent difficulties for participants at GOLD 3 and 4 ($p=0.019$ and $p=0.003$, respectively).

Insert table 4 about here

Environmental factors

Table 5 provides an overview of the frequency and extent of the Environmental factors perceived as facilitators or barriers. Twelve (52.17%) of the 23 categories of this component of the Comprehensive Core Set for OPD were relevant for the participants studied. The Environmental factors most frequently understood as facilitators were immediate family (n=112; 94.12%), health professionals (n=115; 96.64%) and their individual attitudes (n=108; 90.76%), products or substances for personal consumption (n=110; 92.44%) and products and technology for personal use in daily living (n=86; 72.27%). These were also considered as the most substantial facilitators. The environmental factors considered more frequently as a barrier and also as the most severe barriers were the climate (n=100; 84.03%) and the air quality (n=92; 77.31%). The frequency of the Environmental factors considered as facilitators or barriers were similar among participants at different grades of the disease, with the exception of day/night cycles, that was considered more frequent as a barrier by patients at GOLD 4

than patients at GOLD 1 (p=0.035). Regarding the differences in the extent of the Environmental factors among the grades, it was observed that patients at GOLD 4 considered day/night cycles significantly more severe barriers (p=0.044) and health services, systems and policies more important facilitators (p=0.004) than patients at GOLD 1.

Insert table 5 about here

Discussion

In this cross-sectional study, the majority of the categories of the Comprehensive ICF Core Set for OPD were considered as relevant impairments for the participants studied. Therefore, this Core Set allowed the description of the typical spectrum of impairments of the participants' functioning.

Body functions

In general, the impairments in this ICF component were similar among the four grades of COPD. These results are consistent with recent literature, which have shown that the airflow limitation has a weak correlation with the patients' health status [13]. Nevertheless, the impairments of functions, such as exercise tolerance and respiration, were found to increase from GOLD 1 to GOLD 4. Thus, to manage these specific impairments in patients with COPD, the GOLD classification system should be taken into account.

Exercise tolerance functions and sensations associated with cardiovascular and respiratory functions, often referred in the literature as fatigue and dyspnoea, were found to be the most severe impairments and associated with the grade of COPD. These impairments are extremely common in patients with COPD and recent evidence have shown that patients at advanced grades report more dyspnoea than those at earlier grades [14-16]. The impairments on respiratory muscle functions and respiration functions are well-described in the literature and are often assessed in patients with COPD [17,18]. Specifically, impairments in respiratory muscle functions were more frequent in participants at moderate to very severe COPD. This result is in line with the study by Terzano et al., where it was found that airway obstruction is associated with decreased respiratory pressures in patients with COPD [18]. Impairments in muscle power and muscle endurance functions also allowed to distinguish COPD grades. In a study by Seymour et al., which aimed to quantify the weakness of quadriceps in

COPD, it was found that the highest weakness was observed in participants at GOLD 4 [19]. These data emphasises that pulmonary rehabilitation interventions, a recommended standard care for patients with COPD, combining exercise training (endurance and strength training) with respiratory physiotherapy (airway clearance, respiratory re-education and relaxation techniques), should be available for patients with COPD [20]. These interventions should also include respiratory muscle training, since it seems to be a strategy to manage the respiratory dysfunction observed in this population [21]. This reinforces the idea that pulmonary rehabilitation, if followed as recommended by the European Respiratory Society and American Thoracic Society, is organised and structured to address the main body functions impairments of patients with COPD [20].

Emotional impairments, often referred as anxiety and depression, were also the most frequent and are highly associated with COPD [22]. This result showed that it is imperative to investigate the effect of psycho-education sessions with a greater supportive component, since they may increase patient's instrumental and emotional coping abilities to manage the disease's demands. In other chronic diseases, such cancer and chronic liver diseases, evidence revealed that these interventions had a significant effect on improving patients' emotional function [23,24].

Impairments in the voice functions and in the haematological system functions have been described as a less relevant problem for patients with COPD [17,25,26]. Therefore, it is important to consider these functions in the first assessment of the health of patients with COPD, however, they may not be a priority in the rehabilitation interventions plan for this population [10].

Body structures

The impairments in the Body structures were similar among the four grades of COPD. These results, together with those found in the Body functions component, strengthen the findings from recent research, which have been advocating that the grade of the airflow limitation is not directly related to the severity of the disease [13]. In this ICF component, only the impairments of the cardiovascular and respiratory systems structures were considered relevant. As expected by the progressive nature of COPD, the extent of the impairment in the respiratory system structure was different between earlier and advanced grades [2,27]. More than half of the participants had impairments in the cardiovascular system structure. This prevalence is above to the one found by Ewert et al. (35.6%) [17]. However,

this result reflects that the airflow obstruction and the systemic inflammation present in COPD are significant risk factors for cardiovascular diseases [28,29]. From these results it can be established that the presence of cardiovascular disease in patients with COPD has to be carefully considered when planning interventions based in exercise training, particularly endurance training. To answer this concern, it may be imperative to assess the safety of the exercise training in these patients with a maximal cardiopulmonary exercise test as it has been recommended [20].

Impairments in the trunk, head/neck and shoulder structures had a low frequency in the participants studied, which is in line with previous literature [17]. Nevertheless, it is essential to assess these structures in this population, since they can be associated with the respiratory dysfunction [5].

Activities and participation

In contrast with the components discussed above, in the Activities and participation component, it was found that the majority of the restrictions assessed were associated with the grade of the patients' airflow limitation. Participants' most relevant limitations were related to the mobility and were at advanced grades that these limitations were experienced as more severe [30,31]. Acquisition of goods and services was also one of the most relevant limitations reported. In the study by Ewert et al. this problem was also one of the most prevalent [17].

Other restrictions on mobility and domestic life and related to the participation in the community, social and civic life, self-care and general tasks and demands were important for the sample studied, particularly at advanced grades. These results are consistent with the well-known spectrum of restrictions of patients with COPD [17,32,33]. This may be explained by the fact that at advanced grades the symptoms are experienced more severely, and therefore, patients' performance is probably more affected. Also difficulties in speaking were significantly more frequent for participants at advanced grades, which may be explained by the severity of their symptoms, especially dyspnoea. Therefore, assessing speech difficulties may be important in symptomatic patients. Since the majority of participants were retired, restrictions on work and employment activities were expected to be less relevant. However, these restrictions are of valuable interest in patients with COPD at working-ages.

One of the major goals of rehabilitation is to overcome patients' participation restrictions. The Activities and Participation component of the ICF assesses the experience of patients in different life domains. However, this ICF component is not routinely used as an outcome measure in rehabilitation [4,5]. Therefore, assessing the most relevant participation restrictions in patients with COPD would be undoubtedly relevant to ensure that rehabilitation interventions effectively improve patients' involvement in their life situations.

Environmental factors

The facilitation role of immediate family has been observed in other studies about COPD [34] and other chronic diseases [35]. Hence, these results highlight the relevance of supporting the family members of patients with COPD, as they are substantial facilitators of their lives. Health professionals and their attitudes were reported as facilitators. However, in other studies involving patients with COPD, the relationship with health professionals was ambivalent, since it was seen as a facilitator but also as a barrier, specifically in sharing information and in surveillance role [36,37]. Products for personal consumption, where medication and inhaler devices are included, and technology for personal use in daily living were also perceived as facilitators. Grill et al., in a study including inpatients with cardiopulmonary conditions also found that these environmental factors were considered as the most relevant [10]. These results demonstrated the relevance of assessing regularly the need and the adaptability of the products for personal consumption and of the technology for personal use in daily living in this population.

Climate and air quality were seen as severe barriers. Ewert et al. have also found climate to be the most frequent barrier for patients with COPD [17]. In relation to air quality, it was expected since a number of studies have been shown that there is a relationship between air pollution and respiratory diseases morbidity [38].

The perspective about the majority of the Environmental factors was similar among participants at different grades of the disease, which might indicate that contextual factors are perceived in a similar way. Nevertheless, day/night cycles, were considered more often as a severe barrier by participants at GOLD 4. A number of studies demonstrated that early morning is the worst time of day, particularly in patients with severe COPD [34,39,40]. Thus, early morning rehabilitation interventions for patients with

COPD should be considered with caution. Conversely, health services, systems and policies were seen as more important facilitators to participants at GOLD 4, which might emphasise the importance of health services, especially for patients who need more integrated care due the complexity of their symptoms. Therefore, health services, systems and policies should be designed to address the needs of patients with COPD.

A summary of the recommendations for the COPD rehabilitation based on the ICF are shown in table 6.

Insert table 6 about here

Limitations

Limitations of the present study were i) the relatively small convenience sample used and ii) the inclusion of mainly older patients with COPD. A larger sample size, including a higher proportion of patients with COPD at middle-age, would be more representative of the general population with COPD and would allow the establishment of stronger recommendations for the COPD rehabilitation. Another limitation is that only Portuguese patients were included. Patients in other countries or cultures may experience impairments with different frequencies and extents. However, as the ICF framework was used, this study may be used to compare results among different countries and inform rehabilitation recommendations in a common health language in each country and across countries. Also the absence of a valid operationalisation of the ICF categories, which introduce a subjective component in the application of the Comprehensive ICF Core Set for OPD, potentially introduced some bias in the results of the study. However, correspondence intervals with qualifiers and control questions to evaluate the extent of the impairment were developed before data collection to overcome some of these difficulties. In addition, during data collection all interviews were conducted by the same person. It is believed that these procedures have reduced the impact of any potential bias of the results.

Conclusion

This study comprehensively characterised the functioning and health of patients with COPD using the ICF framework. Different information about COPD daily life was therefore, integrated which is not considered in other assessment instruments. In general, functioning of patients at different grades of

COPD was found to be similar and therefore, recommendations are advised for patients at earlier and advanced grades. However, this study also confirmed that the grade of airflow limitation is significantly associated with the presence/severity of some specific impairments, which supports the importance of using the GOLD classification system. Hence, this study allowed the description of recommendations with a worldwide common language to develop comprehensive rehabilitation interventions for patients with COPD. In the future, it would be of valuable interest to compare these results with other studies involving different samples, in different countries and also to examine the applicability of the ICF Core Set for OPD during the rehabilitation process.

Declaration of interest

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Table 1 - Socio-demographic and clinical characteristics of the participants (n=119).

Characteristics	
Age, M±SD(range)	68.71±11.61(42-93)
Male, n(%)	85(71.43%)
Marital status, n(%)	
Single	6(5%)
Married	95(79.80%)
Separated/divorced	4(3.40%)
Widowed	14(11.80%)
Current occupation, n(%)	
Employed	17(14.29%)
Unemployed	6(5.04%)
Retired	96(80.67%)
BMI, M±SD(range)	27.23±4.78 (16.33-39.81)
GOLD classification, n(%)	
GOLD 1	25(21%)
GOLD 2	45(37.80%)
GOLD 3	30(25.20%)
GOLD 4	19(16%)

Table 2 - Frequency and extent of the participants' impairments in the Body functions component (n=119).

ICF code	ICF category title	GOLD 1 (n=25)		GOLD 2 (n=45)		GOLD 3 (n=30)		GOLD 4 (n=19)		Total (n=119)			
		n(%)	M[IQR]	n(%)	M[IQR]	n(%)	M[IQR]	n(%)	M[IQR]	n(%)	M[IQR]	p[a]	p[b]
b455	Exercise tolerance functions	21(84%)	2[2, 3]	42(93.33%)	2[2, 3]	29(96.67%)	3[2, 4]	19(100%)	4[3, 4]	111(93.28%)	3[2, 4]	0.148	**0.001***
b460	Sensations associated with cardiovascular and respiratory functions	22(88%)	2[2, 3]	42(93.33%)	2[2, 3]	28(93.33%)	3[2, 4]	19(100%)	4[3, 4]	111(93.28%)	3[2, 4]	0.479	**0.006***
b445	Respiratory muscle functions	6(24%)	0[0, 0.5]	42(93.33%)	1[1, 1]	30(100%)	2[2, 2]	19(100%)	2[2, 3]	97(81.51%)	1[1, 2]	**0.001***	**0.001***
b440	Respiration functions	17(68%)	1[0, 1]	34(75.56%)	1[0.5, 3]	23(76.67%)	1[0.75, 3]	16(84.21%)	2[1, 3]	90(75.63%)	1[1, 3]	0.667	0.146
b152	Emotional functions	20(80%)	2[1.5, 4]	35(77.78%)	2[1, 3]	22(73.33%)	2[0, 3]	13(68.42%)	2[0, 3]	90(75.63%)	2[1, 3]	0.803	0.794
b1522	Range of emotion	20(80%)	2[1.5, 4]	34(75.56%)	2[0.5, 3]	20(66.67%)	2[0, 3]	13(68.42%)	2[0, 3]	87(73.11%)	2[0, 3]	0.662	0.762
b280	Sensation of pain	19(76%)	2[0.5, 3]	35(77.78%)	2[1, 3]	23(76.67%)	2[0.75, 3]	13(68.42%)	2[0, 3]	83(69.75%)	2[1, 3]	0.734	0.832
b2801	Pain in body part	18(72%)	2[0, 3]	34(75.56%)	2[0.5, 3]	23(76.67%)	2[0.75, 3]	13(68.42%)	2[0, 3]	83(69.75%)	2[0, 3]	0.913	0.863
b410	Heart functions	20(80%)	1[1, 1.5]	28(62.22%)	1[0, 2]	19(63.33%)	1[0, 2]	9(47.37%)	0[0, 1]	76(63.87%)	1[0, 2]	0.163	0.280
b530	Weight maintenance functions	21(84%)	1[1, 2]	26(57.78%)	1[0, 2]	18(60%)	1[0, 1]	11(57.89%)	1[0, 2]	76(63.87%)	1[0, 2]	0.133	0.065
b134	Sleep functions	10(40%)	0[0, 2.5]	30(66.67%)	2[0, 3]	17(56.67%)	2[0, 2]	9(47.37%)	0[0, 2]	66(55.46%)	1[0, 3]	0.156	0.851
b435	Immunological system functions	13(52%)	1[0, 2]	30(66.67%)	1[0, 2]	12(40%)	0[0, 2]	9(47.37%)	0[0, 2]	64(53.78%)	1[0, 2]	0.130	0.583
b450	Additional respiratory functions	13(52%)	1[0, 2]	20(44.44%)	0[0, 2]	17(56.67%)	1[0, 2]	12(63.16%)	1[0, 2]	62(52.10%)	1[0, 2]	0.524	0.906
b130	Energy and drive functions	10(40%)	0[0, 2]	18(40%)	0[0, 2]	17(56.67%)	1[0, 2.25]	14(73.68%)	2[0, 4]	59(49.58%)	0[0, 2]	0.055	0.792
b780	Sensations related to muscles and movement functions	10(40%)	0[0, 2]	24(53.33%)	1[0, 2]	15(50%)	0.5[0, 1.25]	10(52.63%)	1[0, 2]	59(49.58%)	0[0, 2]	0.742	0.692
b730	Muscle power functions	8(32%)	0[0, 1]	15(33.33%)	0[0, 1]	23(76.67%)	1[0.75, 2]	11(57.89%)	1[0, 1]	57(47.90%)	0[0, 1]	**0.001***	0.089
b740	Muscle endurance functions	7(28%)	0[0, 1]	14(31.11%)	0[0, 1]	21(70%)	1[0, 2]	10(52.63%)	1[0, 1]	52(43.70%)	0[0, 1]	**0.002***	0.214
b310	Voice functions	4(16%)	0[0, 0]	5(11.11%)	0[0, 0]	5(16.67%)	0[0, 0]	6(31.58%)	0[0, 1]	20(16.81%)	0[0, 0]	0.259	0.598
b430	Haematological system functions	0	0	5(11.11%)	0[0, 0]	4(13.33%)	0[0, 0]	3(15.79%)	0[0, 0]	12(10.08%)	0[0, 0]	0.274	0.125

Categories with a frequency equal or over 70% are highlighted and statistical significant values are signed in bold and identified with *(α=0.05). M - median; IQR – interquartile range [p_{25}, p_{75}]; a - differences in the frequency of impairments among COPD grades; b - differences in the extent of impairments among COPD grades.

Table 3 - Frequency and extent of the participants' impairments in the Body structures component (n=119).

ICF code	ICF category title	GOLD 1 (n=25)		GOLD 2 (n=45)		GOLD 3 (n=30)		GOLD 4 (n=19)		Total (n=119)			
		n(%)	M[IQR]	n(%)	M[IQR]	n(%)	M[IQR]	n(%)	M[IQR]	n(%)	M[IQR]	p^a	p^b
s430	Structure of respiratory system	25(100%)	1[1, 1]	45(100%)	2[1, 2]	30(100%)	2[2, 3]	19(100%)	3[2, 4]	119(100%)	2[1, 2]	0.054	**0.001***
s410	Structure of cardiovascular system	17(68%)	1[0, 2]	23(51.11%)	1[0, 2]	17(56.67%)	1[0, 2]	9(47.37%)	0[0, 1]	66(55.46%)	1[0, 2]	0.483	0.319
s760	Structure of trunk	6(24%)	0[0, 0.5]	11(24.44%)	0[0, 0.5]	7(23.33%)	0[0, 0.25]	2(10.53%)	0[0, 0]	26(21.85%)	0[0, 0]	0.635	0.634
s710	Structure of head and neck region	4(16%)	0[0, 0]	7(15.56%)	0[0, 0]	5(16.67%)	0[0, 0]	6(31.58%)	0[0,1]	22(18.49%)	0[0, 0]	0.460	0.474
s720	Structure of shoulder region	2(8%)	0[0, 0]	4(8.89%)	0[0, 0]	4(13.33%)	0[0, 0]	2(10.53%)	0[0, 0]	12(10.08%)	0[0, 0]	0.909	0.958

Categories with a frequency equal or over 70% are highlighted and statistical significant values are signed in bold and identified with *(α=0.05). M - median; IQR – interquartile range [p_{25}, p_{75}]; a - differences in the frequency of impairments among COPD grades; b - differences in the extent of impairments among COPD grades.

Table 4 - Frequency and extent of the participants' impairments in the Activities and participation component (n=119).

ICF code	ICF category title	GOLD 1 (n=25)		GOLD 2 (n=45)		GOLD 3 (n=30)		GOLD 4 (n=19)		Total (n=119)			
		n(%)	M[IQR]	n(%)	M[IQR]	n(%)	M[IQR]	n(%)	M[IQR]	n(%)	M[IQR]	p[a]	p[b]
d455	Moving around	20(80%)	0[1, 3]	39(86.67%)	2[1, 3]	28(93.33%)	3[2, 4]	19(100%)	4[3, 4]	106(89.08%)	3[2, 4]	0.153	**0.004***
d460	Moving around in different locations	18(72%)	2[0, 3]	35(77.78%)	2[1, 2]	27(90%)	2[1.75, 4]	17(89.47%)	2[1, 3]	97(81.51%)	2[1, 3]	0.246	0.062
d620	Acquisition of goods and services	17(68%)	2[0.75, 3]	33(73.33%)	2[1, 2]	20(66.67%)	3[1, 4]	15(78.95%)	3[2, 4]	85(71.43%)	2[1, 3]	0.781	0.074
d920	Recreation and leisure	10(40%)	0[0, 2]	27(60%)	1[0, 2]	19(63.33%)	2[0, 4]	19(100%)	3[2, 4]	75(63.03%)	2[0, 3]	**0.001***	0.200
d640	Doing housework	14(56%)	2[0, 2.5]	26(57.78%)	2[1, 3]	16(53.33%)	2.5[1, 4]	15(78.95%)	3[2, 4]	71(59.66%)	2[1, 3]	0.303	0.143
d540	Dressing	11(44%)	0[0, 2.5]	21(46.67%)	0[0, 3]	21(70%)	2[0, 3]	15(78.95%)	2[1, 3]	68(57.14%)	1[0, 3]	**0.023***	0.893
d650	Caring for household objects	11(44%)	2[0, 3]	20(44.44%)	2[0, 3]	18(60%)	2.5[1, 4]	15(78.95%)	3[2, 4]	64(53.78%)	2[1, 3]	**0.049***	0.289
d470	Using transportation	12(48%)	0[0, 2]	22(48.89%)	0[0, 2]	15(50%)	0.5[0, 3]	11(57.89%)	1[0, 2]	60(50.42%)	1[0, 2]	0.913	0.864
d230	Carrying out daily routine	9(36%)	0[0, 1]	20(44.44%)	0[0, 2]	16(53.33%)	1[0, 3]	14(73.68%)	2[0, 3]	59(49.58%)	0[0, 2]	0.075	**0.035***
d510	Washing oneself	11(44%)	0[0, 2]	16(35.56%)	0[0, 2]	17(56.67%)	1[0, 2.25]	14(73.68%)	2[0, 2]	58(48.74%)	0[0, 2]	**0.031***	0.957
d910	Community life	9(36%)	0[0, 1.5]	18(40%)	0[0, 2]	16(53.33%)	1[0, 3]	15(78.95%)	3[1, 4]	58(48.74%)	0[0, 2]	**0.017***	0.342
d450	Walking	6(24%)	0[0, 0.5]	16(35.56%)	0[0, 1]	21(70%)	1[0, 2]	14(73.68%)	1[0, 2]	57(47.90%)	0[0, 1]	**0.001***	0.241
d240	Handling stress and other psychological demands	8(32%)	0[0, 1.5]	16(35.56%)	0[0, 2]	16(53.33%)	1[0, 2]	13(68.42%)	2[0, 4]	53(44.54%)	0[0, 2]	**0.039***	0.300
d430	Lifting and carrying objects	7(28%)	0[0, 1]	14(31.11%)	0[0, 1]	17(56.67%)	1[0, 1.25]	12(63.16%)	1[0, 3]	50(42.02%)	0[0, 1]	**0.016***	0.101
d410	Changing basic body position	5(20%)	0[0, 0]	15(33.33%)	0[0, 1]	16(53.33%)	1[0, 2]	10(52.63%)	10, 2]	46(38.66%)	0[0, 1]	**0.037***	0.197
d770	Intimate relationships	11(44%)	1[0, 3]	13(28.89%)	0[0, 2]	12(40%)	1[0, 3]	10(52.63%)	2[0, 3]	46(38.66%)	0[0, 2]	0.296	0.775
d475	Driving	6(24%)	0[0, 1.75]	15(33.33%)	0[0, 2]	10(33.33%)	0.5[0, 2]	12(63.16%)	2[1, 3]	42(35.29%)	1[0, 2]	**0.040***	0.724
d4750	Driving human-powered transportation	4(16%)	0[0, 2.5]	13(28.89%)	0[0, 2]	10(33.33%)	2[1, 3]	11(57.89%)	2[2, 3]	38(31.93%)	1[0, 2]	**0.029***	0.252
d570	Looking after one's health	9(36%)	0[0, 2]	13(28.89%)	0[0, 1]	6(20%)	0[0, 0]	8(42.11%)	0[0, 1]	36(30.25%)	0[0, 1]	0.363	0.071
d660	Assisting others	3(12%)	0[0, 0]	4(8.89%)	0[0, 0]	9(30%)	0[0, 1]	7(36.84%)	0[0, 2]	23(19.33%)	0[0, 0]	**0.019***	0.128
d330	Speaking	2(8%)	0[0, 0]	0	0	7(23.33%)	0[0, 0.25]	5(26.32%)	0[0, 1]	14(11.76%)	0[0, 0]	**0.003***	0.365
d850	Remunerative employment	3(12%)	2[0, 3]	5(11.11%)	0.5[0, 2]	2(6.67%)	4[4, 4]	3(15.79%)	2[1, 2]	13(10.92%)	2[0, 2.75]	0.789	0.241
d465	Moving around using equipment	1(4%)	3[3, 3]	3(6.67%)	0.5[0, 4]	4(13.33%)	2[0, 4]	4(21.05%)	2[0, 3]	12(10.08%)	2[0, 3.5]	0.215	0.974

d845	Acquiring, keeping and terminating a job	2(8%)	0[0, 3]	5(11.11%)	0[0, 2]	2(6.67%)	4[4, 4]	3(15.79%)	3[1, 3]	12(10.08%)	1[0, 4]	0.743	0.553

Categories with a frequency equal or over 70% are highlighted and statistical significant values are signed in bold and identified with *(α=0.05). M - median; IQR – interquartile range [p_{25}, p_{75}]; a - differences in the frequency of impairments among COPD grades; b - differences in the extent of impairments among COPD grades.

ICF code	ICF category title	GOLD 1 (n=25)	GOLD 2 (n=45)	GOLD 3 (n=30)	GOLD 4 (n=19)	Total (n=119)	p^a	p^b

Table 5 – Frequency and extent of the Environmental factors perceived as facilitators (F) or barriers (B) (n=119).

			n(%)	M[IQR]	n(%)	M[IQR]	n(%)	M[IQR]	n(%)	M[IQR]	n(%)	M[IQR]		
e310	Immediate family	B F	2(8%) 22(88%)	4[2.5, 4]	1(2.22%) 43(95.56%)	4[3.5, 4]	0 30(100%)	4[3, 4]	1(5.26%) 17(89.47%)	4[2, 4]	4(3.36%) 112(94.12%)	4[3, 4]	0.216	0.209
e355	Health professionals	B F	0 23(92%)	4[2, 4]	0 44(97.78%)	4[3, 4]	0 29(96.67%)	0[2, 4]	0 19(100%)	3[3, 4]	0 115(96.64%)	4[3, 4]	0.480	0.336
e110	Products or substances for personal consumption	B F	0 22(88%)	4[2, 4]	0 43(95.56%)	4[3, 4]	0 27(90%)	4[3, 4]	1(5.26%) 18(94.74%)	4[3, 4]	1(0.84%) 110(92.44%)	4[3, 4]	0.651	0.668
e450	Individual attitudes of health professionals	B F	0 21(84%)	2[1, 3.5]	0 40(88.89%)	2[2, 3.5]	1(3.33%) 28(93.33%)	3[2, 4]	0 19(100%)	3[2, 4]	1(0.84%) 108(90.76%)	2[2, 4]	0.312	0.209
e225	Climate	B F	21(84%) 0	-3[-3,-1.5]	34(75.56%) 2(4.44%)	-3[-3,-0.5]	26(86.67%) 0	-3[-3.25,-1]	19(100%) 0	-3[-4,-3]	100(84.03%) 2(1.68%)	-3[-3,-2]	0.098	0.355
e260	Air quality	B F	16(64%) 1(4%)	-2[-4, 0]	35(77.78%) 2(4.44%)	-3[-4,-1]	24(80%) 2(6.67%)	-3[-4,-1]	17(89.47%) 0	-3[-4,-3]	92(77.31%) 5(4.20%)	-3[-4,-1]	0.259	0.847
e115	Products and technology for personal use in daily living	B F	0 19(76%)	3[2, 4]	0 33(73.33%)	4[2, 4]	0 20(66.67%)	2.5[0.75, 4]	0 14(73.68%)	2.5[0.75, 4]	0 86(72.27%)	3[2, 4]	0.877	0.172
e580	Health services, systems and policies	B F	6(24%) 10(40%)	0[-1,-2]	7(15.56%) 26(57.78%)	2[0, 3]	7(23.33%) 17(56.67%)	1[-0.25, 2.25]	1(5.26%) 15(78.95%)	3[2, 4]	21(17.65%) 68(57.14%)	2[0, 3]	0.084	**0.004***
e410	Individual attitudes of immediate family members	B F	1(4%) 15(60%)	2[0, 2]	0 25(55.56%)	2[0, 2]	0 22(73.33%)	2[0, 4]	0 13(68.42%)	1[0, 3]	1(0.84%) 75(63.03%)	2[0, 3]	0.422	0.384
e320	Friends	B F	0 13(52%)	1[0, 3.5]	1(2.22%) 22(48.89%)	1[0, 3]	1(3.33%) 12(40%)	0[0, 3]	0 10(52.63%)	1[0, 3]	2(1.68%) 57(47.90%)	1[0, 3]	0.719	0.983
e245	Time-related changes	B F	8(32%) 0	0[-1, 0]	19(42.22%) 1(2.22%)	0[-2, 0]	18(60%) 0	-1[-2, 0]	12(63.16%) 0	-2[-3, 0]	57(47.90%) 1(0.84%)	0[-2, 0]	0.121	0.052
e2450	Day/night cycles	B F	7(28%) 1(4%)	0[-1,0]	19(42.22%) 1(2.22%)	0[-2, 0]	18(60%) 0	-1[-2, 0]	12(63.16%) 0(0%)	-2[-3, 0]	56(47.06%) 2(1.68%)	0[-2, 0]	**0.035***	**0.044***
e150	Design, construction and building products and technology of buildings for public use	B F	3(12%) 3(12%)	0[0, 0]	2(4.44%) 5(11.11%)	0[0, 0]	8(26.67%) 3(10%)	0[-1, 0]	6(31.58%) 4(21.05%)	0[-2, 0]	19(15.97%) 15(12.61%)	0[0, 0]	0.258	0.301
e155	Design, construction and building products and technology of buildings for private use	B F	3(12%) 3(12%)	0[0, 0]	2(4.44%) 4(8.89%)	0[0, 0]	8(26.67%) 3(10%)	0[-1, 0]	5(26.32%) 3(15.79%)	0[-1, 0]	18(15.13%) 13(10.92%)	0[0, 0]	0.293	0.448
e540	Transportation services, systems and policies	B F	1(4%) 3(12%)	0[0, 0]	4(8.89%) 7(15.56%)	0[0, 0]	2(6.67%) 5(16.67%)	0[0, 0]	1(5.26%) 7(36.84%)	0[0, 4]	8(6.72%) 22(18.49%)	0[0, 0]	0.262	0.363
e420	Individual attitudes of friends	B F	0 3(12%)	0[0, 0]	0 8(17.78%)	0[0, 0]	0(0%) 2(6.67%)	0[0, 0]	0(0%) 2(10.53%)	0[0, 0]	0(0%) 15(12.61%)	0[0, 0]	0.548	0.439
e460	Societal attitudes	B F	0 0	0[0, 0]	0 4(8.89%)	0[0, 0]	2(6.67%) 3(10%)	0[0, 0]	1(5.26%) 3(15.79%)	0[0, 0]	3(2.52%) 10(8.40%)	0[0, 0]	0.612	0.430
e120	Products and technology for personal indoor and outdoor mobility and transportation	B F	0 1(4%)	0[0, 0]	0 4(8.89%)	0[0, 0]	0 1(3.33%)	0[0, 0]	0 3(15.79%)	0[0, 2]	0 9(7.56%)	0[0, 0]	0.369	0.552
e575	General social support services, systems and policies	B F	1(4%) 1(4%)	0[0, 0]	0 2(4.44%)	0[0, 0]	2(6.67%) 0	0[0, 0]	2(10.53%) 1(5.26%)	0[0, 0]	5(4.20%) 4(3.36%)	0[0, 0]	0.320	0.293
e555	Associations and organizational services, systems and policies	B F	0 0	0	1(2.22%) 3(6.67%)	0[0, 0]	1(3.33%) 0	0[0, 0]	1(5.26%) 1(5.26%)	0[0, 0]	3(2.52%) 4(3.36%)	0[0, 0]	0.587	0.430
e340	Personal care providers and personal assistants	B F	0 2(8%)	0[0, 0]	1(2.22%) 1(2.22%)	0[0, 0]	0 0	0	0 0	0	1(0.84%) 3(2.52%)	0[0, 0]	0.287	0.738
e585	Education and training services, systems	B	0	0	1(2.22%)	0[0, 0]	1(3.33%)	0[0, 0]	0	0[0, 0]	2(1.68%)	0[0, 0]	0.469	0.325

	and policies	F	0		1(2.22%)		0		1(5.26%)		2(1.68%)			
e590	Labour and employment services, systems and policies	B	0	0	0	0[0, 0]	1(3.33%)	0[0, 0]	0	0[0, 0]	1(0.84%)	0[0, 0]	0.269	0.368
		F	0		1(2.22%)		0		1(5.26%)		2(1.68%)			

Categories with a frequency equal or over 70% are highlighted and statistical significant values are signed in bold and identified with *(α=0.05). M - median; IQR – interquartile range [p_{25}, p_{75}]; a - differences in the frequency of impairments among COPD grades; b - differences in the extent of impairments among COPD grades.

Table 6 - Summary of the recommendations for the COPD rehabilitation based on the ICF.

ICF Components	Recommendations
Body functions	▪ Pulmonary rehabilitation interventions, combining exercise training with respiratory physiotherapy, should be available for patients with COPD. ▪ Respiratory muscle training should be offered for patients with respiratory dysfunction. ▪ A greater supportive component should be incorporated in the psycho-education sessions designed for patients with COPD.
Body structures	▪ The safety of the exercise training in patients with COPD should be assessed through a maximal cardiopulmonary exercise test. ▪ Impairments in the trunk, head/neck and shoulder structures should be assessed since they are related to the respiratory dysfunction.
Activities and participation	▪ The most relevant participation restrictions in patients with COPD should be used to evaluate the effectiveness of rehabilitation interventions. ▪ Speech difficulties should be evaluated in symptomatic patients. ▪ Restrictions on work and employment activities should be considered in patients with COPD at working-ages.
Environmental factors	▪ Psycho-education should be offered to family members of patients with COPD. ▪ The need and the adaptability of the products for personal consumption and of the technology for personal use in daily living should be regularly assessed. ▪ Early morning rehabilitation interventions for patients with COPD should be considered with caution. ▪ Health services, systems and policies should be designed to address the needs of patients with COPD.